this [illegible] re-

NEW PENNSYLVANIAN LUNGFISHES FROM ILLINOIS

ROBERT H. DENISON

FIELDIANA: GEOLOGY
VOLUME 12, NUMBER 12
Published by
FIELD MUSEUM OF NATURAL HISTORY
SEPTEMBER 17, 1969

FIELDIANA · GEOLOGY

Volume 12, No. 12 September 17, 1969 Publication 1076

New Pennsylvanian Lungfishes from Illinois

ROBERT H. DENISON
CURATOR, FOSSIL FISHES

The concretions from the Middle Pennsylvanian Francis Creek Shale of the Mazon Creek–Braidwood area of Will and Grundy Counties, Illinois, have yielded not uncommon scales of lungfishes that are generally identified, following Romer and Smith (1934, p. 703), as *Sagenodus occidentalis* (Newberry and Worthen). The only lungfish tooth reported from Mazon Creek has been referred to *Ctenodus* by Romer and Smith (1934, p. 702). The collections made in recent years in the same formation in Pit 11 of the Peabody Coal Company on either side of the Will–Kankakee County line contain a quite different and varied fauna (Johnson and Richardson, 1966). It includes an occasional scale that is doubtfully referable to *Sagenodus*, and two poorly preserved but articulated, juvenile lungfishes that are not generically identifiable (p. 208). In addition, there are four specimens, three of which are very small, articulated individuals, that are clearly *Conchopoma*. The latter comes typically from the Lower Permian of Lebach, Germany, but has been recorded from the United States. Steen (1931) described a parasphenoid of this genus from Linton, Jefferson County, Ohio, and Donald Baird has collected specimens of *Conchopoma* at Linton for the Princeton Museum of Natural History—one a parasphenoid, another a cranial roof, and associated skeletal parts. In addition, the Linton species described by Cope (1873) as *Conchiopsis exanthematicus* and *Peplorhina anthracina* have been referred to *Conchopoma* by Romer and Smith (1934, p. 718), but the status of these species requires examination.

Cope (1873, p. 343) established *Peplorhina* on a single species, *P. anthracina*, based on a single specimen in Newberry's collection, which was not identified, and has not been figured. The original description is as follows:

"*Peplorhina*, Cope. Established on a species similar to those of the last genus [*Conchiopsis*], but with a peculiar sculpture of the

Library of Congress Catalog Card Number: 77–92918

scales, which consists of raised points or small tubercles. There is a lateral line of tubes which I cannot find in *Conchiopsis*. An angular bony shield is present behind the gular scutum. There are well-ossified ribs, but the structure of the fins cannot be made out at present.

"*Peplorhina anthracina*, Cope. Scales large, well imbricated; each one is .01 mm. in elevation, and three enter .02 longitudinally. The gular and other scuta are smooth, except a band of shallow grooves round the margin."

One specimen in the Newberry collection at the American Museum of Natural History, no. 8580, fits this description and may be identified as the type specimen. However, neither on the surface nor in X-ray does it show many characters. The "angular bony shield" is an unidentified cranial plate, and the "gular scutum" is probably an opercular. The "peculiar sculpture of the scales . . . small tubercles" is present, but not on scales, whereas small patches of fine-ridged ornament, not mentioned by Cope, may be scales. I conclude that there is little or nothing on this specimen that can be considered as diagnostic of the genus or species, and so *Peplorhina anthracina* may be considered a *nomen vanum*.

The type species of *Conchiopsis*, *C. filiferus* Cope (1873), has been referred to *Coelacanthus* (later to *Rhabdoderma*), and so this genus and species need not be considered further here. However, *Conchiopsis exanthematicus* Cope was referred to *Peplorhina anthracina* by Newberry (1873, p. 425), and Cope (1875, p. 410) and others have followed this. Newberry may have been correct, but considering the inadequate preservation of the type of *P. anthracina*, there is little evidence for it. The type specimen of *C. exanthematicus* was not designated by Cope, but it can be identified quite certainly, in spite of a discrepancy in Cope's measurements, as American Museum no. 8898, part of Newberry's collection, and figured by Cope in 1875 (pl. 35, fig. 6). This preserves an incomplete denticulated parasphenoid, not shown in Cope's figure, and thus can be referred with confidence to *Conchopoma*. However, in its present condition it shows nothing that could be used to characterize the species.

In 1875 Cope figured three other specimens as *Peplorhina anthracina*. These appear on his plate 42, but the descriptions of the figures are given by mistake on the legend for plate 41. Figure 4 can be identified as American Museum no. 1097, and shows scattered cranial roof plates, an incomplete operculum, a patch of palatal teeth, and a ceratohyal, surely of *Conchopoma*. Figure 5 is American Museum

no. 8645, and is part of a cranial roof, probably of *Sagenodus serratus* (Newberry). I have not seen the specimen on Figure 6, but it resembles a bone B, not of *Conchopoma*.

In 1877 (p. 54), Cope described a second species of *Peplorhina*, *P. arctata*, based on a denticulated plate (Field Museum, UC 6511) from the Upper Pennsylvanian of Vermilion County, Illinois. At that time, Cope considered it to be a crossopterygian, but later (1882, p. 461, footnote) he considered it to be a "theromorphous saurian." Case (1900, pp. 707–708) thought that the type might be from the palate of cotylosaur, while Hussakof (1911, pp. 170–171) referred it to the actinopterygian *Sphaerolepis* Fritsch. In my opinion the type, and a referred specimen from the same Illinois locality (Field Museum, UC 6512), probably represent lower tooth plates of *Conchopoma* such as will be described below.

I conclude that at present three or four species of *Conchopoma* are valid according to the International Code, but only the type species, *C. gadiforme* Kner, is well enough known to be characterized satisfactorily. *C. anthracinum* (Cope) and *C. exanthematicum* (Cope), which may be synonyms, are *nomina vana*. *C. arctatum* (Cope) is based only on lower tooth plates and cannot be compared adequately with the type species; its tooth plates differ, as will be shown, from those of the species to be described below.

Conchopoma edesi[1] n. sp.

Type.—Field Museum, PF 5611, a small but nearly complete fish, mostly laterally compressed, and preserved in counterpart (figs. 103–104, 109); collected by Thomas Edes.

Referred specimens.—Field Museum, PF 5695, a small, nearly complete specimen, dorso-ventrally compressed, and preserved in counterpart (figs. 107–108); collected by James Konecny of Mokena, Illinois.

H 389 in collection of Jerry Herdina of Berwyn, Illinois, the anterior half of a small, articulated fish, flattened dorso-ventrally, and preserved in counterpart (figs. 105–106).

Parasphenoid of a larger individual in counterpart, in the collection of Mr. and Mrs. Francis A. Wolff of Park Forest, Illinois.

Horizon.—Middle Pennsylvanian, Francis Creek shale.

[1] This species is gratefully named after Thomas Edes of Aurora, Illinois, who collected the type specimen and donated it to Field Museum.

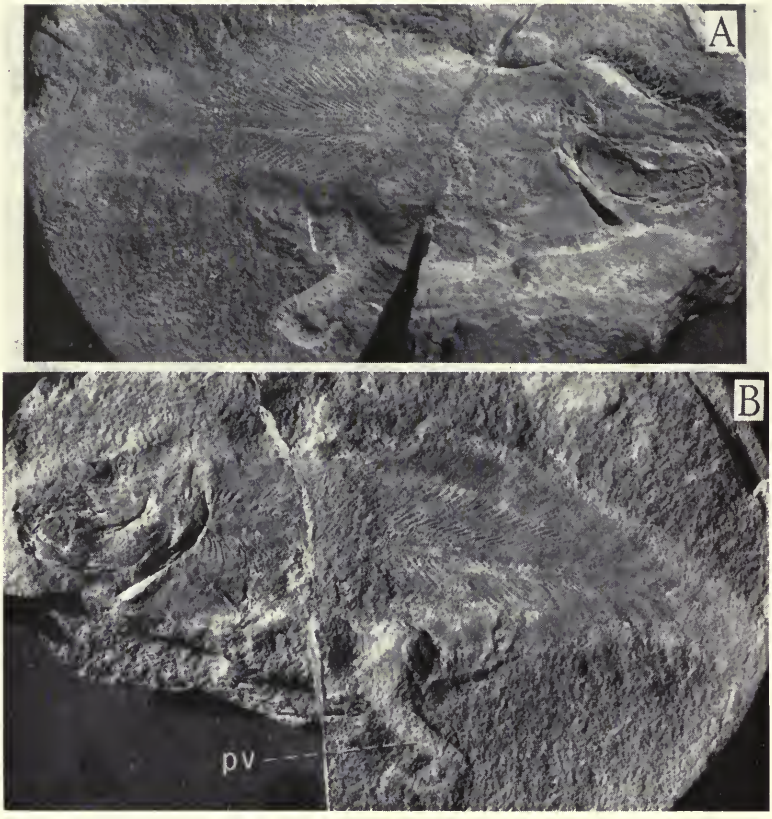

FIG. 103. *Conchopoma edesi*, n. sp., type, PF 5611 (× 3/2). Specimen is preserved in counterpart as a negative, and shows laterally compressed body, one pelvic fin (*pv*), and remnants of a color pattern. A, impression of left side; B, impression of right side.

Locality.—Pit 11 of the Peabody Coal Company, Will and Kankakee Counties, Illinois.

Diagnosis.— A *Conchopoma* with extremely long and relatively slender pectoral and pelvic fins, with thin, cycloidal scales, and with subrectangular lower tooth plates.

Description and discussion.—The three articulated specimens of *Conchopoma edesi* are all small and presumably juvenile individuals. The type has an estimated total length of 70 mm., and a head length (measured to the posterior edge of the opercular) of 14.5 mm. PF 5695 is somewhat smaller, its total length being 54.5 mm., and its head length 13.8 mm. On the assumption that these specimens have not

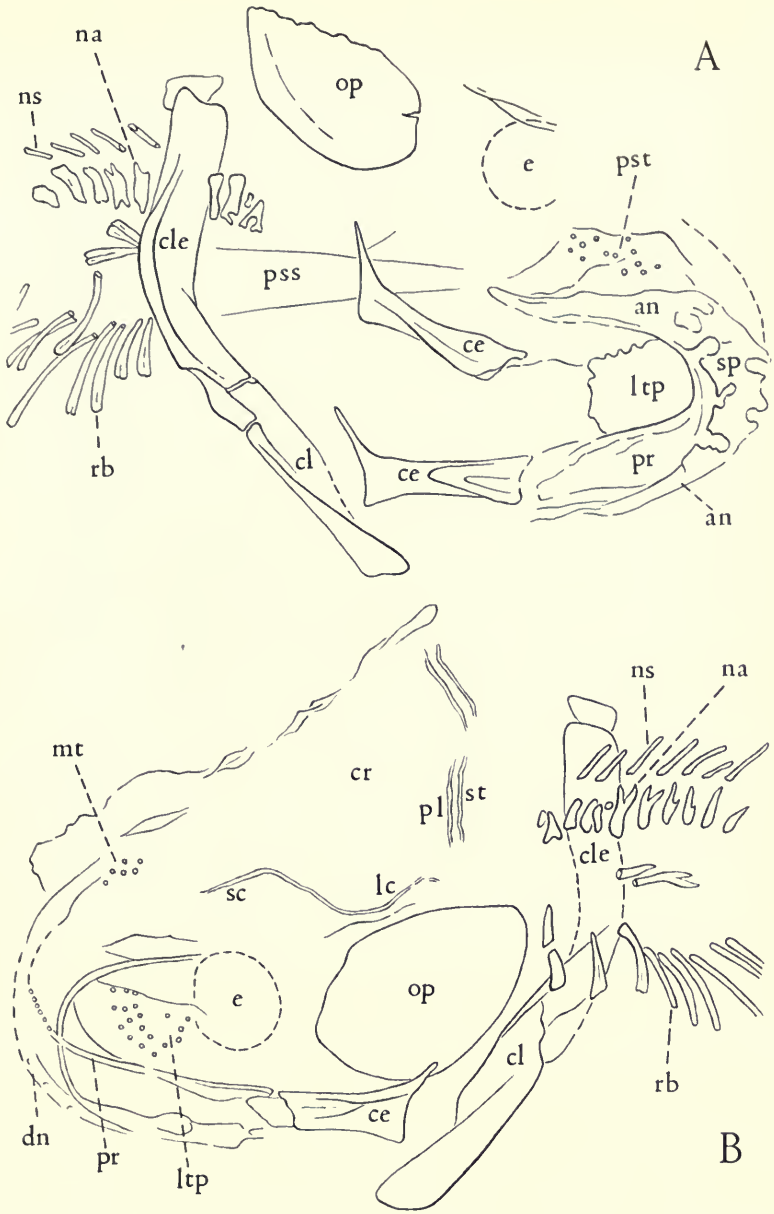

FIG. 104. *Conchopoma edesi*, n. sp., head of type specimen, PF 5611 (× 5). A, drawn from latex impression of Figure 1B; B, drawn from latex impression of Figure 1A. *an*, angular; *ce*, ceratohyal; *cl*, clavicle; *cle*, cleithrum; *cr*, cranial roof; *dn*, dentary; *e*, eye; *lc*, main lateral-line canal; *ltp*, lower tooth plate; *mt*, marginal teeth of lower jaw; *na*, neural arch; *ns*, neural spine; *op*, opercular; *pl*, posterior pit line; *pr*, prearticular; *pss*, parasphenoid stem; *pst*, parasphenoid teeth; *rb*, rib; *sc*, supraorbital canal; *sp*, splenial-postsplenial; *st*, supratemporal canal.

FIG. 105. *Conchopoma edesi*, H 389 of Herdina collection (× 2); latex positives made from original specimen, which is preserved in counterpart as a negative. Fish is dorso-ventrally compressed, and posterior part is not exposed. A, ventral view; B, dorsal view.

been greatly distorted except for flattening, these measurements conform to the findings of Kner (1868, pp. 282, 286) and Weitzel (1926, p. 160) in the Lebach *Conchopoma gadiforme* that the head of smaller specimens is relatively larger. The ratio in *C. edesi* of head length to total length is .21 to .25, compared to .20 to .28 in measured specimens of *C. gadiforme*. The largest articulated specimen, H 389, is incomplete, but must have had a total length of about 85 mm. The isolated parasphenoid in the Wolff collection had a total length of

57 mm. or more, and must have come from a fish at least 280 mm. long.

The most characteristic feature of *Conchopoma* is the presence of numerous small, closely-spaced teeth on the anterior parts of the parasphenoid and pterygoids (Watson and Gill, 1923, fig. 29B), instead of the typical lungfish tooth plates. These are best shown on the Wolff collection parasphenoid, which resembles, except in its larger size, the parasphenoid of *Conchopoma* sp. from Linton, Ohio, described by Steen in 1931. The former has a narrow, dorsally-channelled, posterior stem, and a broad anterior plate, concave ventrally, and covered in its anterior half by numerous, close-spaced, small, bluntly-conical teeth. Among the articulated specimens of *C. edesi*, the palatal teeth are best shown in H 389 (fig. 106, *pst*), where the median teeth are on the parasphenoid, but the lateral ones are presumably on the pterygoids, though sutures between these bones cannot be made out in this region. During growth of an individual *Conchopoma*, small palatal teeth must have been replaced by larger and more numerous teeth, but the available material does not reveal how this was accomplished.

The three articulated specimens of *C. edesi* clearly demonstrate that the parasphenoid-pterygoid teeth were opposed by a median lower tooth plate (figs. 104, 106A, 108, *ltp*). One was recognized in *C. gadiforme* by Kner (1868, p. 288) and by Weitzel (1926, p. 164; pl. 18, figs. 1–3; pl. 19, fig. 6), and may be the displaced bone labelled "R.P.ART." in this species by Watson and Gill (1923, fig. 29). In *C. edesi* it is an irregularly rectangular bone lying just behind the symphysis of the lower jaws, antero-median to the anterior ends of the large ceratohyals, and bearing on its dorsal surface small, bluntly-conical teeth similar to those on the palate. From its position it would appear to be borne, not by the lower jaws, as are the paired tooth plates of typical Dipnoi, but by the anterior end of the hyoid arch, presumably by the basihyal. A median, hyoidean tooth plate is not known to occur in other lungfishes, but comparable plates do occur in a number of teleosts, notably in the Osteoglossidae. The lower tooth plate of *C. edesi* differs in shape from that of *C. arctatum*, which has a smoothly-rounded anterior and lateral margin, a straight, transverse posterior margin, and short, oblique postero-lateral margins.

Another unusual feature of *Conchopoma edesi* is the presence of marginal teeth, at least in the lower jaws. In PF 5611 (fig. 104B, *mt*) small teeth occur on bones lying on the inner sides of the lower jaws,

the prearticulars (or MdI of Jarvik, 1967, p. 158). In H 389 none are seen on the prearticulars, but there are definite denticulations on the external lower jaw bones (fig. 106B, *dn*), the dentaries (or MdX of Jarvik). These teeth may be compared to those of larval *Neoceratodus* as figured by Semon (1901, fig. B). The outer series corresponds to the paired teeth $x_1 - x_5$ of Semon's figure, which are lost in the adult *Neoceratodus*; the inner series corresponds to $o_1 - o_3$ and $p_1 - p_2$ of Semon's figure, which are thought to be modified to form the adult lower tooth plates. Marginal teeth also occur on the type of *Conchopoma exanthematicum* (American Museum 8898), as recognized by Cope (1873, p. 342), but their precise position cannot be determined. The presence of marginal teeth in the upper jaws cannot be demonstrated in any specimen of *Conchopoma* that I have seen; however, Kner (1868, p. 280) mentions five or six small conical teeth on the upper margin of the mouth of *C. gadiforme*.

Marginal teeth, as well as marginal jaw bones, have been lost in the majority of dipnoans, and their presence in *Conchopoma* may be regarded as a primitive character. One other late Paleozoic genus, *Uronemus*, has denticles on its "dentary" (Watson and Gill, 1923, p. 204, fig. 30A), and the Devonian genera, *Dipterus* and *Holodipterus*, may have small marginal teeth on the "dentary" and "upper lip" (Traquair, 1878, p. 8; Gorizdro-Kulczycka, 1950, p. 87, fig. 1; Gross, 1964, pp. 11–15, fig. 2).

The lower jaws of *Conchopoma edesi* show some interesting features, though not all are easy to interpret. The lower face of the anterior part is covered by fenestrated bones, fused at the symphysis in PF 5611 (fig. 104A, *sp*), but with an open, interdigitating suture in H 389 (fig. 106A, *sp*). The latter is very similar in this respect to the type of *C. exanthematicum* as figured by Cope (1875, pl. 35, fig. 6), though some of this specimen has apparently been lost since Cope's figure was drawn. These bones are the splenials and postsplenials of Watson and Gill (1923) and called MdMc1 by Jarvik (1967, p. 161). Behind these bones are the so-called angulars (figs. 104A, 106A, 108,

---

FIG. 106. *Conchopoma edesi*, head of H 389 of Herdina collection (× 5); drawn from latex positives made from original specimen. A, ventral view; B, dorsal view. *an*, angular; *ce*, ceratohyal; *cl*, clavicle; *cle*, cleithrum; *crp*, posterior margin of cranial roof; *dn*, dentary; *ltp*, lower tooth plate; *na*, neural arch; *ns*, neural spine; *orb*, orbit; *pr*, prearticular; *ps*, parasphenoid; *pss*, parasphenoid stem; *pst*, parasphenoid teeth; *pt*, pterygoid; *rb*, rib; *sp*, splenial-postsplenial.

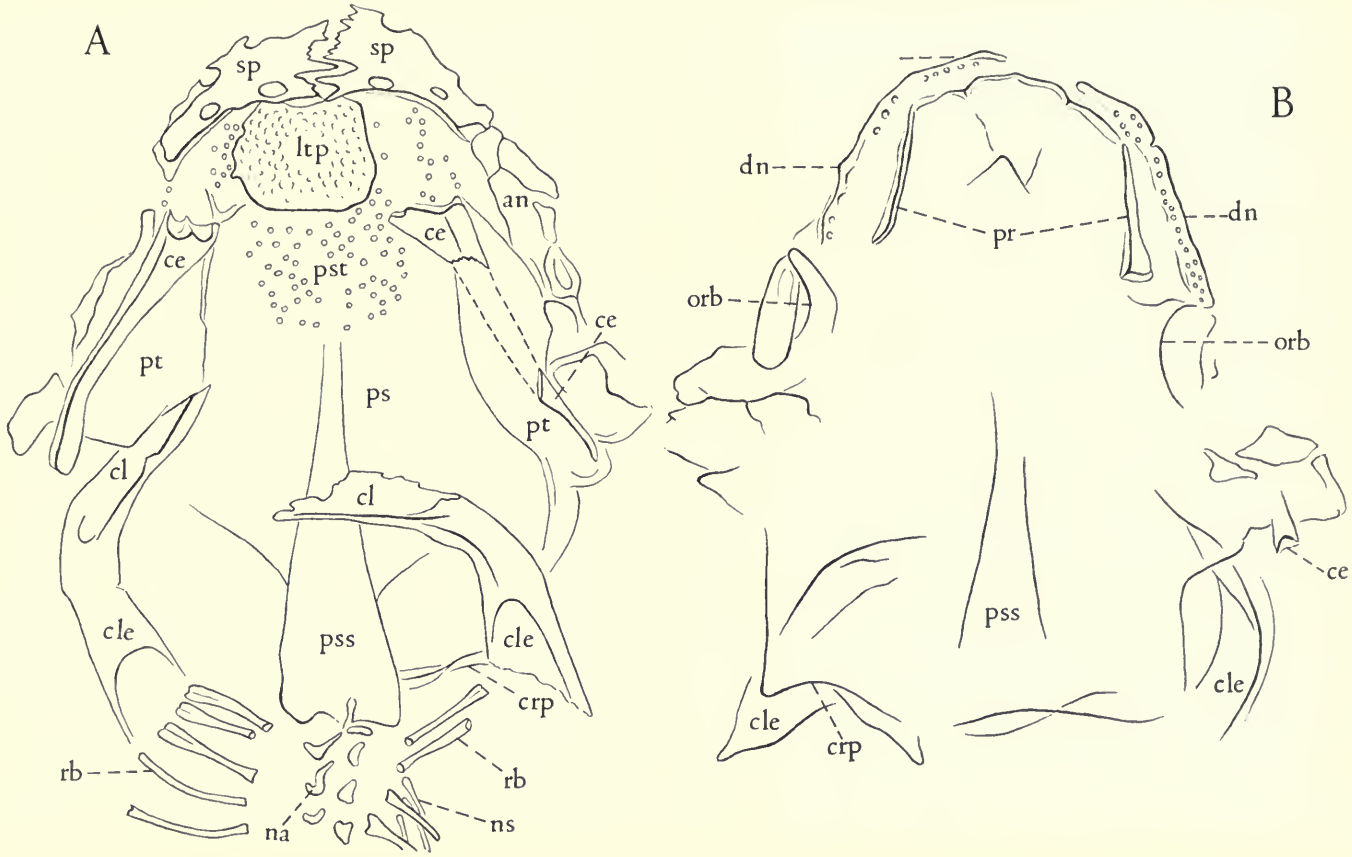
A
sp
sp
ltp
an
ce
ce
pst
ce
pt
ps
pt
cl
cl
cle
pss
cle
crp
rb
rb
na
ns
B
dn
pr
dn
orb
orb
ce
pss
cle
cle
crp

FIG. 107. *Conchopoma edesi*, PF 5695 (× 2). Fish is dorso-ventrally compressed and preserved as a negative. Pectoral fins (*pe*) are lighter bands projecting laterally behind the head.

an), named MdE by Jarvik. The anterior margin of the jaw is covered dorsally by the sometimes denticulated bone often called dentary (figs. 104B, 106B, 108, *dn*), but named MdX by Jarvik (1967, pp. 159, 173–175), who questions its homology with the dentary of other fishes. In H 389 these bones are denticulate and extend far back toward the posterior part of the lower jaw. In dorsal view the other paired lower jaw elements are recognizable, and distinctly denticulate in PF 5611 (fig. 104B, *pr*); these are the prearticulars of Watson and Gill, or MdI of Jarvik. They carry no tooth plates, as in typical dipnoans, but lie anterior and lateral to the lower, hyoidean tooth plate.

Of the skull itself, very little can be made out of the available specimens of *Conchopoma edesi*. The cranial roof is preserved in impression in PF 5611 and H 389, but the bones are so crushed that sutures cannot be determined. On PF 5611 and 5695 there are two pairs of curved, parallel grooves on the posterior part of the impression of the inner surface of the cranial roof (figs. 104B, 108, *pl, st*); on the bone itself they would, of course, have been ridges on the inner side. According to Westoll (1949, p. 155), the lateral-line canals formed ridges on the inner surfaces of cranial roof bones of *Conchopoma*, and Romer (1936, p. 246, footnote) pointed out that the lateral lines formed grooves on the inner surfaces of the bones of *Sagenodus*.

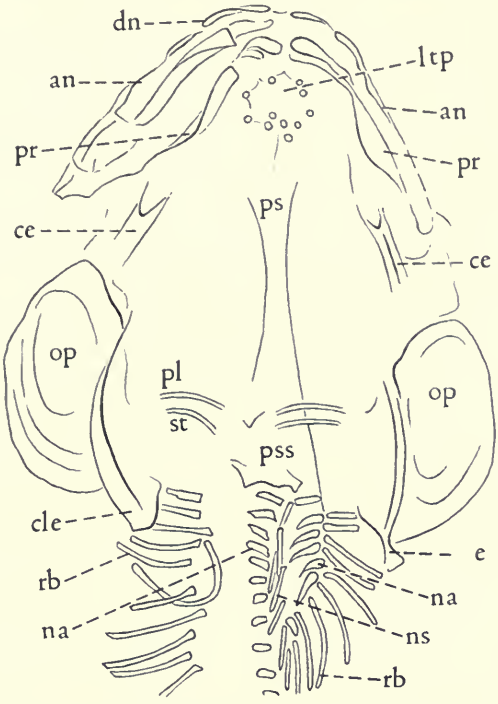

FIG. 108. *Conchopoma edesi*, head of PF 5695 (× 5), drawn from latex positive made from the original negative shown in Figure 5; this is a dorsal view of a dorsoventrally compressed specimen. *an*, angular; *ce*, certatohyal; *cle*, cleithrum; *dn*, dentary; *ltp*, lower tooth plate; *na*, neural arch; *ns*, neural spine; *op*, opercular; *pl*, posterior pit line; *pr*, prearticular; *ps*, parasphenoid; *pss*, parasphenoid stem; *rb*, rib; *st*, supratemporal canal.

So in *Conchopoma edesi* the internal ridges presumably represent lateral lines, and can be homologized with the posterior pit lines and supratemporal canals of other lungfishes, though it is clear that they were both canals, not superficial pit lines. PF 5611 also shows a similarly developed longitudinal canal (fig. 104B, *lc*, *sc*) which probably is the main lateral line and supraorbital canal. On the type of *C. edesi* the position of the eyes is indicated by black, pigmented spots (fig. 104, *e*). The opercular plates (figs. 104, 108, *op*), after which *Conchopoma* was named, are prominent in all specimens, though displaced in H 389, and often show growth lines.

The shoulder girdle is preserved in all three articulated specimens, but displayed best in the type, where the inner and outer surfaces of the right shoulder girdle can be seen. The cleithrum (figs. 104, 106, 108, *cle*) appears to be relatively narrower from front to back than

restored by Weitzel (1926, fig. 26) in *Conchopoma gadiforme*, and by Watson and Gill (1923, fig. 19A) in *Sagenodus*, but this may be due in part to incomplete preservation. Its structure agrees with that of *Sagenodus*, showing a marked ridge along the posterior edge on the outer side, continuing into a ventral process that overlaps the clavicle posteriorly, and a ventral lamina on the inner face that attaches to the clavicle. The clavicles (figs. 104, 106A, *cl*) are well developed, not small as indicated by Watson and Gill (1923, p. 201), and have a marked external ridge along the posterior edge, continuing that of the cleithrum.

As in most lungfishes, there are no ossifications of the centra in *Conchopoma edesi*. The vertebral column is represented by slender, rod-like neural spines (figs. 104, 106A, 108, *ns*) and by separately ossified paired elements that are presumably neural arches (figs. 104, 106A, 108, *na*). There are no paired ventral ossifications such as Weitzel (1926, fig. 29) illustrated in *C. gadiforme*. In the posterior part of the body, behind the ribs, there are ossified haemal spines. The ribs are short, gently curved rods, expanded slightly at the heads, but tapering little or not at all distally. The first two, or perhaps three (fig. 106A), which lie between the shoulder girdles, are relatively stout and broadened distally, and are comparable to the cranial ribs of *Neoceratodus*.

The median fin of *Conchopoma edesi* (fig. 103) differs in one respect from that of *C. gadiforme*, as described by Weitzel (1926, p. 169), in that the radial elements supporting the dermal fin rays are widely separated from the neural and haemal spines. Presumably, there were cartilaginous proximal radial elements connecting the distal radials to the neural and haemal spines, and their unossified state may be a specific distinction, or it may be due to the juvenile condition of the articulated specimens of *C. edesi*.

The paired fins of *C. edesi* are remarkable for their extreme length, a characteristic that distinguishes it not only from *C. gadiforme*, but also from all other fossil lungfishes. The only fin preserved on the type specimen, a pelvic fin (figs. 103, *pv*; 109), is so long relative to the size of the fish that, when this was the only known specimen, it was seriously questioned whether the fin belonged to this individual. The matter was settled definitely with the discovery of PF 5695 (fig. 107), which preserves not only a similar pelvic fin, but also correspondingly long, slender pectoral fins (fig. 107, *pe*). In the latter, the shape of the pectoral fins is indicated by lighter-colored areas on the matrix, stippled with minute pigment spots similar to those on the body. In

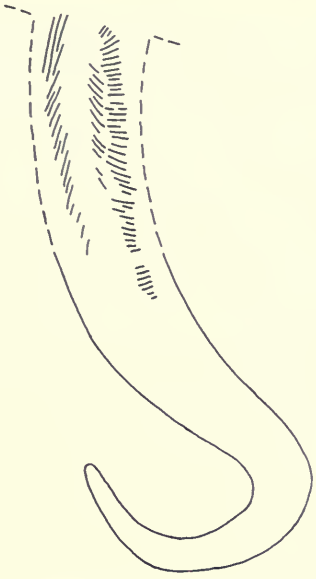

FIG. 109. *Conchopoma edesi*, pelvic fin of type specimen, PF 5611 (× 5), showing dermal fin rays.

PF 5611 a very distinct light-colored area indicates the shape of the pelvic fin. In none of the paired fins is there any sign of ossified axial or radial elements, but the pelvic fins show dermal fin rays in their proximal parts (fig. 109). These fins are comparable to, and may have had a function similar to that of the paired fins of the living *Protopterus*, which were even more slender, though relatively shorter. According to Johnels and Svensson (1954, pp. 150–155), *Protopterus* uses its paired fins for "walking" on the bottom during quiet locomotion, and for support off the bottom when at rest. In addition, its fins are provided with sense organs that are used for detection of food on the bottom. The paired fins of *C. gadiforme* have been restored by Weitzel (1926, fig. 29) with more normal dipnoan proportions.

The scales are extremely thin, judging by the manner in which they are closely applied around the surfaces of vertebral elements and fin radials. For this reason it is difficult to determine their size and shape; however, a row of scales between the neural spines and dorsal fin radials of the type are quite well defined. They are elliptical in shape, about 1.4 mm. antero-posteriorly by 1.2 mm. dorsoventrally, and are covered with fine ridges of which there are about 20–25 per millimeter. The ridges are arranged longitudinally through

the middle part of the scale, but dorsally and ventrally curve to follow those margins of the scale. Weitzel (1926, p. 171, fig. 11) shows the scales of *C. gadiforme* as rhombic, which is not the case in *C. edesi*. Kner (1868, p. 281) says the scales of *C. gadiforme* cover the fins to their margins, but I cannot trace them onto the fins of *C. edesi*. Scales of *Conchopoma* from Linton show fine ridges on their external surfaces, similar to those of *C. edesi*.

One of the interesting features of the type specimen of *C. edesi* (fig. 103B) is that it preserves a color pattern on the posterior part of the body. This consists of diagonal alternating darker and lighter bands, oriented parallel to the dermal fin rays of the median fin, and extending from this onto the dorsal and ventral parts of the body.

The preservation of the three articulated specimens gives definite indications about the shape of the body of *Conchopoma edesi*. PF 5695 (fig. 107) is compressed dorso-ventrally in its head and anterior half of its body; the posterior half of its body is twisted gradually so that by the time the tip of the tail is reached, the median fins are lying horizontally in the plane of the bedding. The head and anterior body are broad, and the pectoral fins are directed straight laterally. H 389 (fig. 105) has only the head and anterior half of the body exposed, but they agree with PF 5695 in being dorso-ventrally compressed. The preservation of the type, PF 5611 (fig. 103), is different. The head is crushed obliquely so that the cranial roof is flattened into the same plane as the cheek and operculum of one side, but the body is entirely laterally compressed in the bedding plane, as is one pelvic fin below it. One may conclude from this that the head was broader than high, and that the body gradually became laterally compressed behind the head, much as it does in *Neoceratodus*. Weitzel (1926, p. 173) found similar preservation in *C. gadiforme*, and came to similar conclusions regarding body shape.

Conchopoma is unique and aberrant among lungfishes in the character of its dentition. In the absence of typical tooth plates it surely could have crushed only relatively soft food. It has none of the mechanisms that would have enabled it to cut or crush plant food. Its total adaptation—small size, limited swimming ability, relatively small mouth, and absence of sharp teeth, indicate that it was not ordinarily a predator on other fishes. However, its small, blunt marginal and palatal teeth would have enabled it to catch and hold small aquatic animals such as larvae of insects, fish or amphibians, as well as worms and soft-bodied crustaceans.

There has been a difference of opinion regarding the evolutionary position of *Conchopoma*. Watson and Gill (1923, p. 214) and Lehman (1959, p. 34) came to the conclusion that the denticulated palate was derived from the ridged tooth plates that characterize most lungfishes, while Weitzel (1926, p. 167) believed that the denticulation was primary. Watson and Gill argued that the whole structure of the dipnoan skull was modified to support crushing tooth plates, and therefore the two must have evolved together. This argument is reasonable, but there are points in favor of the opposite view. First, there are a number of genera of lungfishes, most of them early ones, which evolved other types of teeth than the typical tooth plate, and so it would appear that early in lungfish evolution there was considerable experimentation with different biting mechanism. Second, most but not all of the *Conchopoma* upper dentition is on the parasphenoid, while the typical lungfish tooth plates are carried on the pterygoids. Third, there is nothing in other lungfishes comparable to the median hyoidean lower tooth plate of *Conchopoma*, for the typical paired lower tooth plates were carried on the prearticular, and are comparable only to the prearticular teeth of *C. edesi*. Finally, the retention of marginal teeth on bones possibly homologous to dentaries is surely a primitive feature in *Conchopoma*, lost in most lungfishes, and suggests that the evolution of this genus was distinct from very early times. I would then consider *Conchopoma* to represent a distinct line of Dipnoi, worthy of placement in a family of its own, the Conchopomatidae Berg. A relationship to *Uronemus*, as suggested by some, is not indicated.

On the basis of both the type species and *C. edesi*, the genus *Conchopoma* can be diagnosed as follows:

Dipnoi lacking the usual dental plates, but provided with small conical teeth on the anterior parts of the parasphenoid and pterygoids, opposed by a median lower tooth plate borne by the basihyal. Small marginal teeth also present sometimes on the upper and lower jaws. Skull roof with a large central bone (D), large paired bones on the posterior parts of the supraorbital canals, and large, paired postero-lateral bones. Lateral-line canals on the inner surfaces of the cranial roof bones. Centra unossified, and neural spines ossified separately from neural arches. Median fins continuous with the diphycercal tail. Head depressed, but body laterally compressed posteriorly.

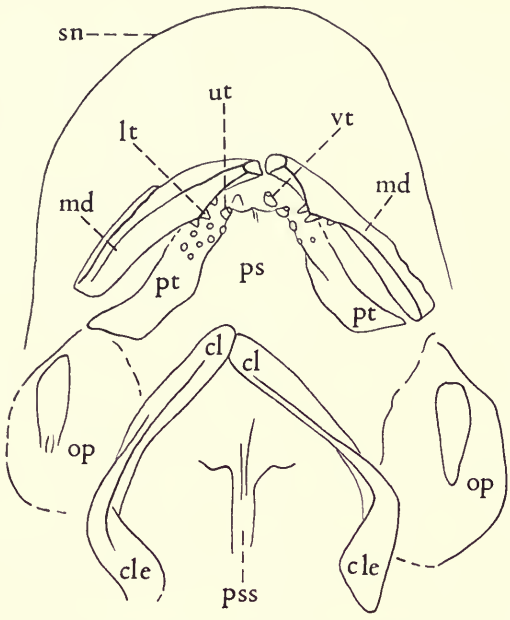

FIG. 110. Undetermined dipnoan, PF 5707, head and shoulder girdle in ventral view (× 10); drawn from latex positive of original negative. *cl*, clavicle; *cle*, cleithrum; *lt*, lower teeth; *md*, lower jaw; *op*, opercular; *ps*, parasphenoid; *pss*, parasphenoid stem; *pt*, pterygoid; *sn*, possible outline of snout; *ut*, upper or pterygoid teeth; *vt*, ? vomerine teeth.

UNDETERMINED JUVENILE DIPNOI

Two very small, articulated, but incomplete lungfishes from Pit 11 differ from *Conchopoma* in the absence of denticulated parasphenoids and lower tooth plates. Both are dorso-ventrally compressed and lack the posterior part of the body. PF 5707 (Field Museum) probably had a total length in life of less than 30 mm., while H 388 (Herdina collection) may have been about 40 mm. long. Because of their small size and imperfect preservation few details can be made out, so generic identification is impossible. However, PF 5707, studied both in the original negative, and as a latex positive made from it (fig. 110), shows some interesting features of the head, which is dorso-ventrally flattened and seen from the ventral side. The lower jaws (fig. 110, *md*), which are slightly separated at the symphysis, form the anterior margin of the skeleton as preserved. They were twisted during compression so that, though seen mostly from the ventral side, three conical teeth can be seen on each inner dorsal margin

(fig. 110, *lt*). In front of the lower jaws is a flat area of matrix which is distinguished from the surrounding matrix by its numerous small flecks of white mineral matter. Because of its evenly convex shape (fig. 110, *sn*), and its extension down either side of the lower jaws, it is tempting to think that this area represents the anterior part of the head, which lacks ossification in all but primitive lungfishes, and so is usually not preserved. Directly behind the lower jaws the palate is well displayed, with the pterygoids (fig. 110, *pt*) lying on either side of the relatively broad parasphenoid (fig. 110, *ps*, *pss*). Instead of meeting as is usual in the midline, the pterygoids appear to be widely separated anteriorly. Each bears a number of conical teeth anteriorly (fig. 110, *ut*), and on one side their arrangement is not unlike that of the larval *Neoceratodus*, as figured by Semon (1901, pl. 19, fig. 11). At least two rows of teeth are present, one medial and the other lateral. A large pair of teeth (fig. 110, *vt*) anterior to the medial rows is slightly more dorsal in position, and may be either the vomerine teeth or the most anterior teeth of the medial rows. PF 5707 is about half again as large as the largest larva of *Neoceratodus* available to Semon in his study of the development of the tooth plates, but its pterygoid teeth are similar in being relatively few in number and still clearly distinct, individual teeth. By the addition of more teeth, growth of all teeth at their bases, and wear at their crowns, the teeth could develop into tooth plates similar to those of such a genus as *Sagenodus*. H 388, which is similar in many respects to PF 5707 except for its larger size, may have already developed tooth plates, but their structure is obscure.

REFERENCES

CASE, E. C.

1900. The vertebrates from the Permian bone bed of Vermilion County, Illinois. Jour. Geol., **8**, pp. 698–729, pls. 1–5.

COPE, E. D.

1873. On some new Batrachia and fishes from the Coal-measures of Linton, Ohio. Proc. Acad. Nat. Sci. Philadelphia, **25**, pp. 340–343.

1875. Synopsis of the extinct Batrachia from the Coal Measures. Rept. Geol. Surv. Ohio, **2**, pt. 2, Palaeont., pp. 350–411, figs. 1–11, pls. 26–45.

1877. On the Vertebrata of the bone bed in eastern Illinois. Proc. Amer. Phil. Soc., **17**, pp. 52–63.

1882. Third contribution to the history of the Vertebrata of the Permian formation of Texas. Proc. Amer. Phil. Soc., **20**, pp. 447–461.

GORIZDRO-KULCZYCKA, Z.

1950. Les dipneustes dévoniens du massif de S-te Croix. Acta Geol. Polonica, **1**, pp. 53–105, figs. 1–2, pls. 1–4.

GROSS, W.

1964. Über die Randzähne des Mundes, die Ethmoidalregion des Schädels und die Unterkiefersymphyse von *Dipterus oervigi* n. sp. Paläont. Z., **38**, pp. 7–25, figs. 1–3, pls. 1–3.

HUSSAKOF, L.

1911. The Permian fishes of North America. Publ. Carnegie Inst. Washington, **146**, pp. 155–175, figs. 53–56, pls. 26–32.

JARVIK, E.

1967. On the structure of the lower jaw in dipnoans: with a description of an early Devonian dipnoan from Canada, *Melanognathus canadensis* gen. et sp. nov. Jour. Linn. Soc. London (Zool.), **47**, pp. 155–183, figs. 1–9, pls. 1–6.

JOHNELS, A. G. and G. S. O. SVENSSON

1954. On the biology of *Protopterus annectens* (Owen). Ark. Zool., ser. 2, **7**, pp. 131–164, figs. 1–13.

JOHNSON, R. G. and E. S. RICHARDSON, JR.

1966. A remarkable Pennsylvanian fauna from the Mazon Creek area, Illinois. Jour. Geol., **74**, pp. 626–631.

KNER, R.

1868. Über *Conchopoma gadiforme* nov. gen. et spec. und *Acanthodes* aus dem Rothliegenden (der untern Dyas) von Lebach bei Saarbrücken in Rheinpreussen. Sitz.-Ber. Akad. Wiss. Wien, Math.-Nat. Kl., **57** (1), pp. 278–305, pls. 1–8.

LEHMAN, J.-P.

1959. Les dipneustes du Dévonien supérieur du Groenland. Medd. om Grønland, **160**, nr. 4, pp. 1–58, figs. 1–30, pls. 1–21.

NEWBERRY, J. S.
1873. Notes on the genus *Conchiopsis* Cope. Proc. Acad. Nat. Sci. Philadelphia, **25**, pp. 425–426.

ROMER, A. S.
1936. The dipnoan cranial roof. Amer. Jour. Sci., ser. 5, **32**, pp. 241–256, figs. 1–4.

ROMER, A. S. and H. J. SMITH
1934. American Carboniferous dipnoans. Jour. Geol., **42**, pp. 700–719, figs. 1–7.

SEMON, R.
1901. Die Zahnentwickelung des *Ceratodus forsteri*. Denkschr. Med.-Naturw. Ges. Jena, **4**, Lief 3, pp. 113–135, figs. A–M, pls. 18–20.

STEEN, M. C.
1931. Note on a parasphenoid of *Conchopoma* from the Middle Coal Measures of Linton, Ohio. Ann. Mag. Nat. Hist., (10), **8**, p. 608, pl. 22.

TRAQUAIR, R. H.
1878. On the genera *Dipterus*, Sedg. & Murch., *Palaedaphus*, Van Beneden and De Koninck, *Holodus*, Pander, and *Chetrodus*, M'Coy. Ann. Mag. Nat. Hist., (5), **2**, pp. 1–17, pl. 3.

WATSON, D. M. S. and E. L. GILL
1923. The structure of certain Palaeozoic Dipnci. Jour. Linn. Soc., Zool., **35**, pp. 163–216, figs. 1–34.

WEITZEL, K.
1926. *Conchopoma gadiforme* Kner, ein Lungenfisch aus dem Rothliegenden. Abhandl. Senck. Naturforsch. Ges., **40**, pp. 159–178, pls. 18–23.

WESTOLL, T. S.
1949. On the evolution of the Dipnoi. *In* Jepsen, G. L., E. Mayr, and G. G. Simpson, eds. Genetics, Paleontology, and Evolution. Princeton Univ. Press. Pp. 121–184, figs. 1–11.

Publication 1076